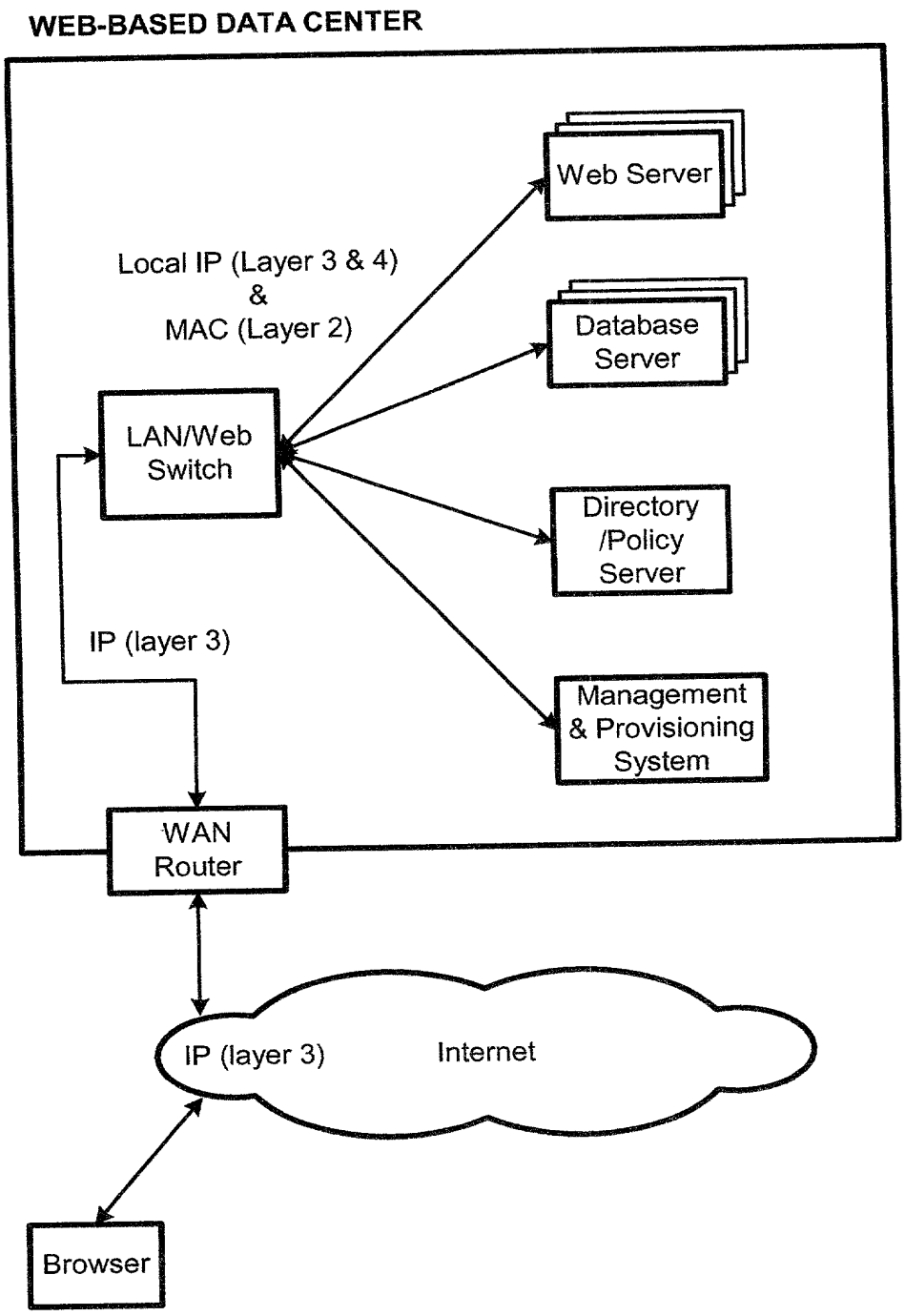


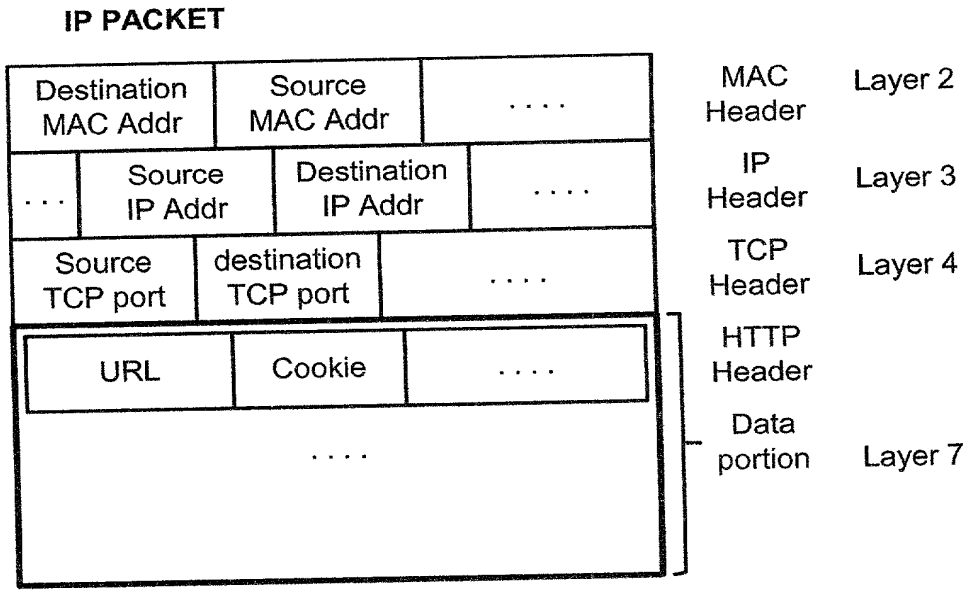
PRIOR ART

FIG. 1

Protocol Layer	OSI	TCP/IP Protocol Stacks	Router/ Switch
7	Application	Application	
6	Presentation		
5	Session		
4	Transport	Transport (TCP)	Web Switch
3	Network	Internet (IP)	Router
2	Data Link	Subnet (MAC)	LAN Switch
1	Physical		

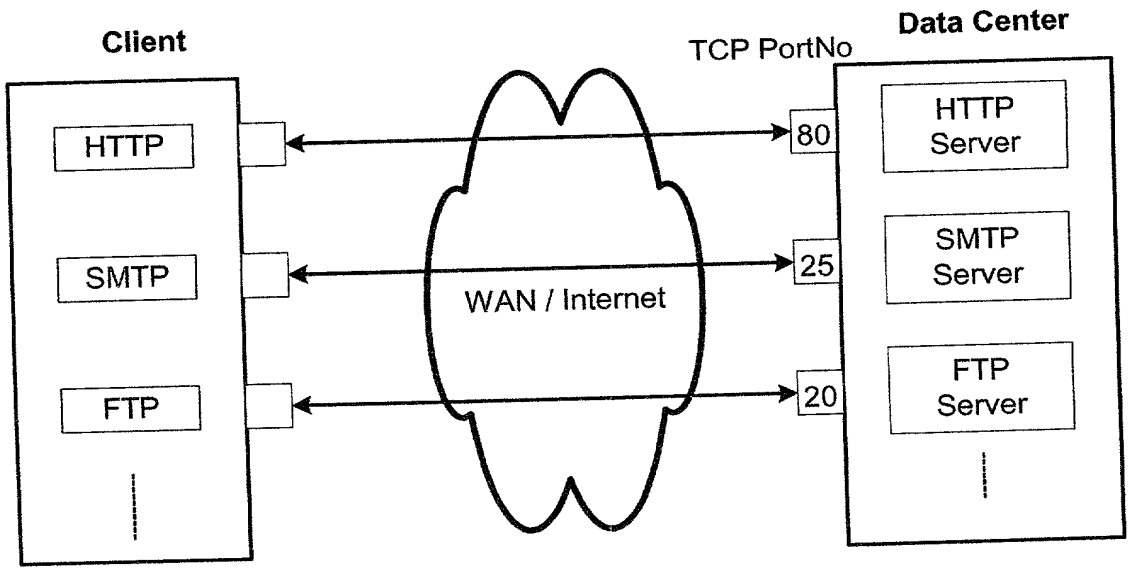
PRIOR ART

FIG. 2



PRIOR ART

FIG. 3



Well-Known TCP port (Softport) Connections

FIG. 4 ***PRIOR ART***

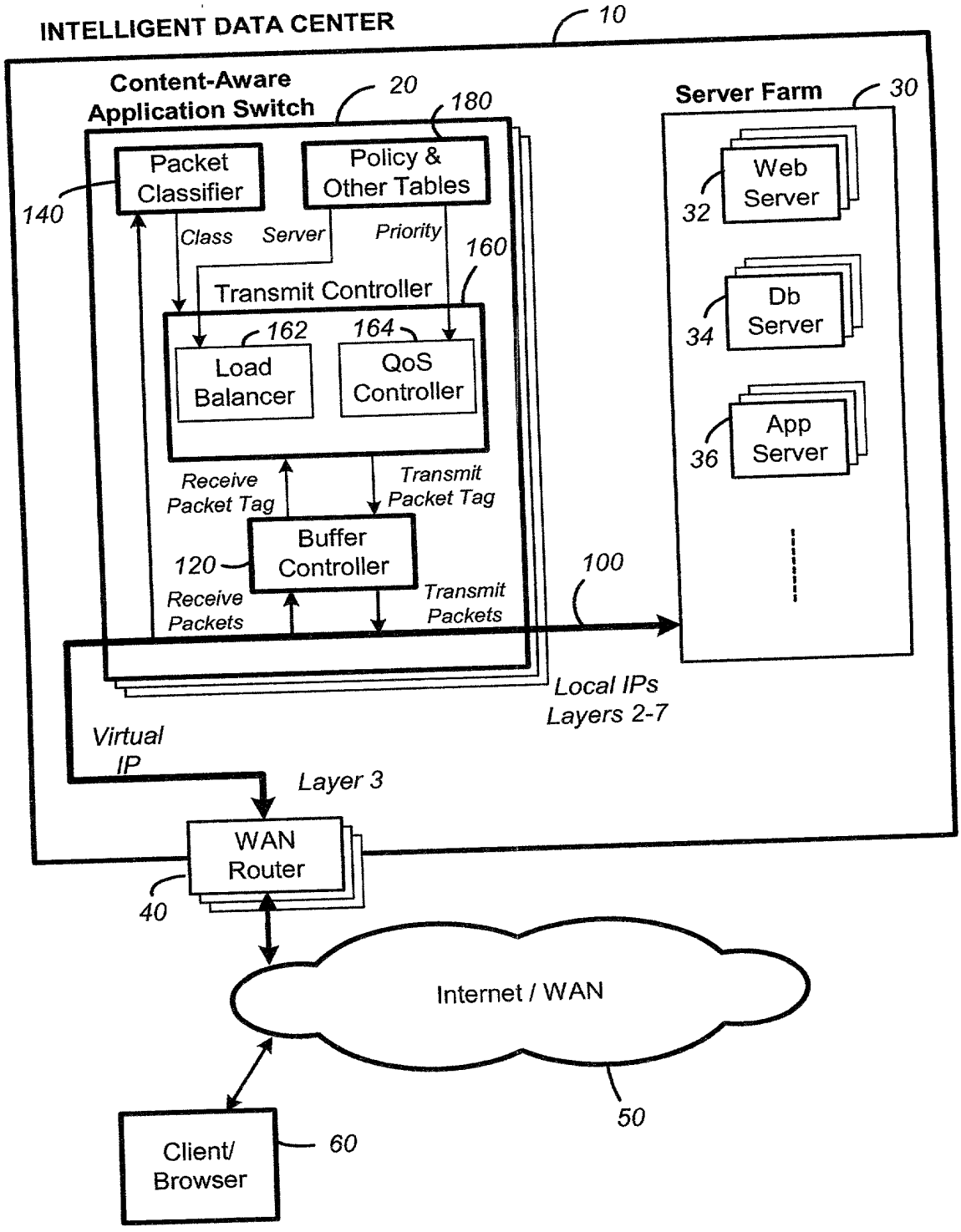

INTELLIGENT DATA CENTER
10
Content-Aware
Application Switch
20
180
Server Farm
30
Packet
Classifier
140
Policy &
Other Tables
Class
Server
Priority
160
Transmit Controller
162
164
Load
Balancer
QoS
Controller
Receive
Packet Tag
Transmit
Packet Tag
Buffer
Controller
120
Receive
Packets
Transmit
Packets
100
Web
Server
32
Db
Server
34
App
Server
36
Local IPs
Layers 2-7
Virtual
IP
Layer 3
WAN
Router
40
Internet / WAN
50
Client/
Browser
60

FIG. 5

Protocol Layer	TCP/IP	Message	Router/ Switch
5-7	**Application**	**HTTP Payload:** Data & Other Personalized Information	**Content-Aware Application Switch**
		HTTP Header: URL, Ref, Host, Cookie, ...	
4	Transport	TCP PortNos	Web Switch
3	Internet	IP Addresses	Router
2	Subnet	MAC Addresses	Lan Switch
1			

FIG. 6

PACKET TAG

Packet ID	Buffer Address	Priority	Previous packet ID	Next packet ID	----	Selected Server

FIG. 9

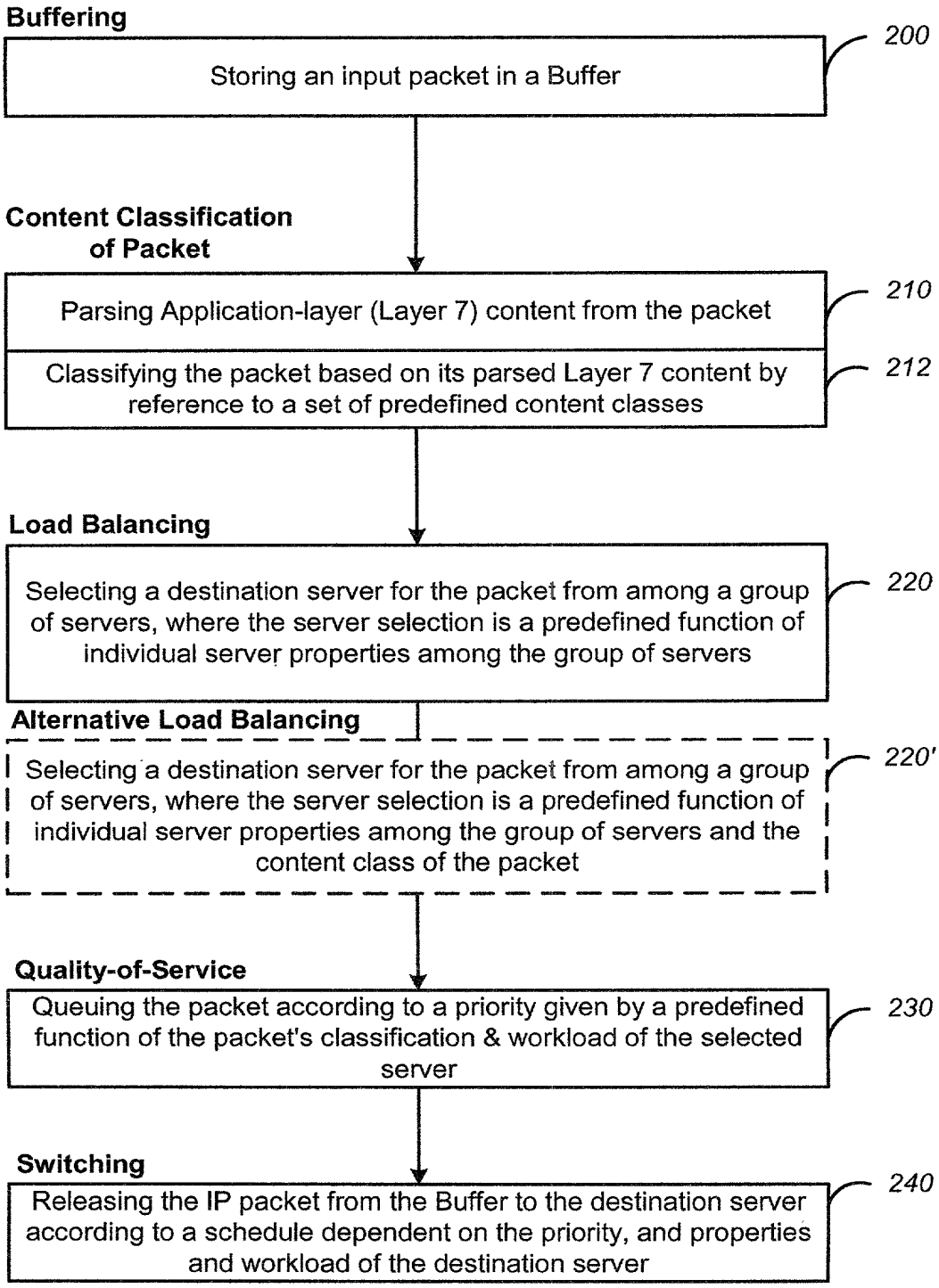

Buffering
Storing an input packet in a Buffer
200
Content Classification of Packet
Parsing Application-layer (Layer 7) content from the packet
210
Classifying the packet based on its parsed Layer 7 content by reference to a set of predefined content classes
212
Load Balancing
Selecting a destination server for the packet from among a group of servers, where the server selection is a predefined function of individual server properties among the group of servers
220
Alternative Load Balancing
Selecting a destination server for the packet from among a group of servers, where the server selection is a predefined function of individual server properties among the group of servers and the content class of the packet
220'
Quality-of-Service
Queuing the packet according to a priority given by a predefined function of the packet's classification & workload of the selected server
230
Switching
Releasing the IP packet from the Buffer to the destination server according to a schedule dependent on the priority, and properties and workload of the destination server
240

FIG. 7

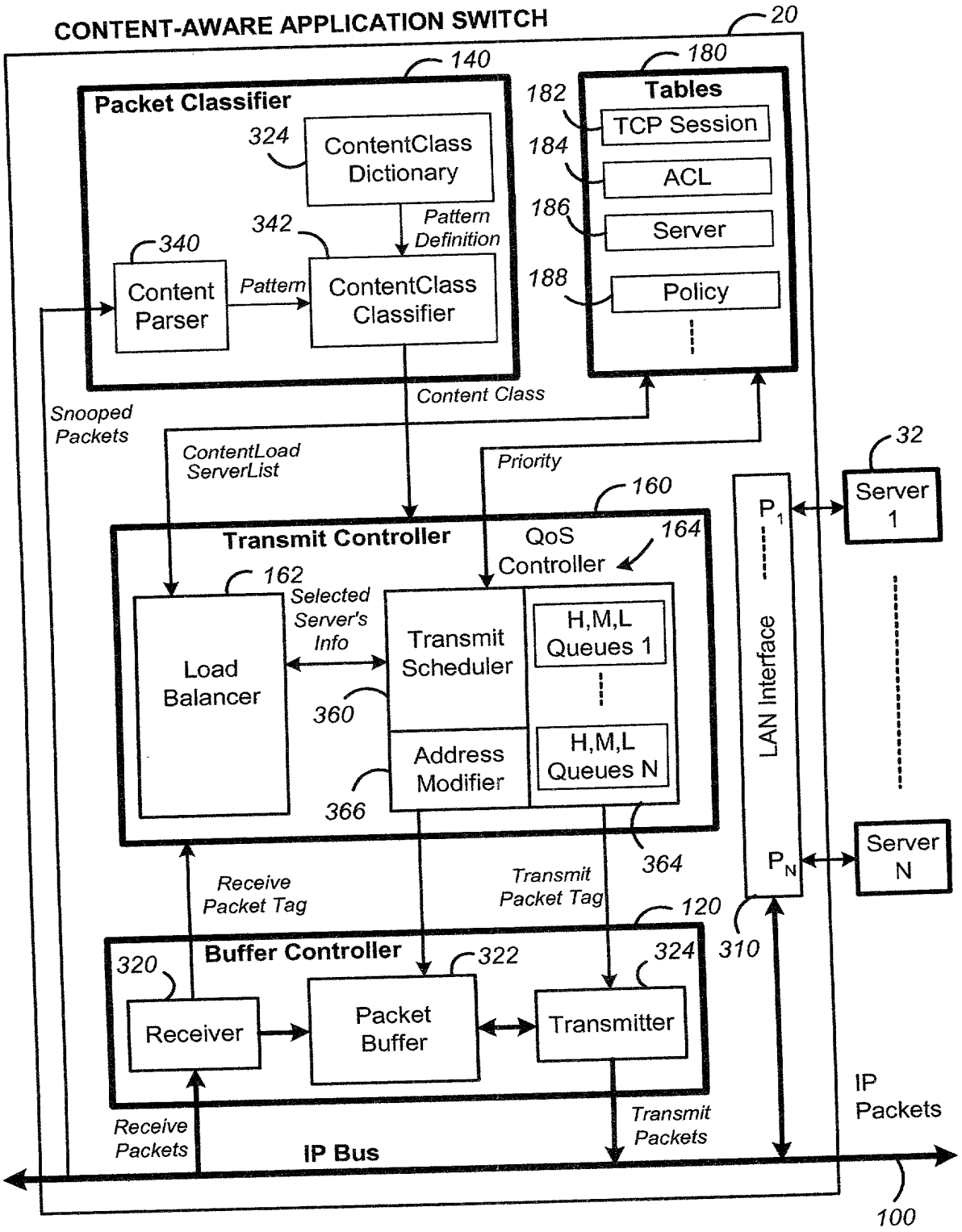

CONTENT-AWARE APPLICATION SWITCH
20
140
Packet Classifier
324
ContentClass Dictionary
Pattern Definition
342
340
Content Parser
Pattern
ContentClass Classifier
180
Tables
182
TCP Session
184
ACL
186
Server
188
Policy
Content Class
Snooped Packets
ContentLoad ServerList
Priority
160
Transmit Controller
QoS Controller
164
162
Load Balancer
Selected Server's Info
Transmit Scheduler
H,M,L Queues 1
H,M,L Queues N
360
Address Modifier
366
364
LAN Interface
P1
PN
32
Server 1
Server N
Receive Packet Tag
Transmit Packet Tag
120
310
Buffer Controller
320
322
324
Receiver
Packet Buffer
Transmitter
Receive Packets
Transmit Packets
IP Bus
IP Packets
100

FIG. 8

CLASS CONTENT DICTIONARY

CLASS	Pattern
1	....
2	....
.	.
.	.
.	.
K	....

FIG. 10A

CLASS POLICY TABLE

CLASS	Priority	Server Group	Class Weight
1	....	....	....
2	....	....	....
.	.		
.	.		
.	.		
K	....	....	....

FIG. 10B

SERVER PROPERTY

Server	IP & MAC Addresses	Max Connections	Default Server Weight	LOW Margin	HIGH Margin
1	....	....	....	....	....
2	....	....	....	....	....
. . .				. . .	
N	....	....	....	....	....

FIG. 10C

SERVER STATE

Server	Current Connections	Current Load	Dynamic Server Weight	Count k
1	....	....	....	....
2	....	....	....	....
. . .	. . .		. . .	
N	....	....	....	....

FIG. 10D

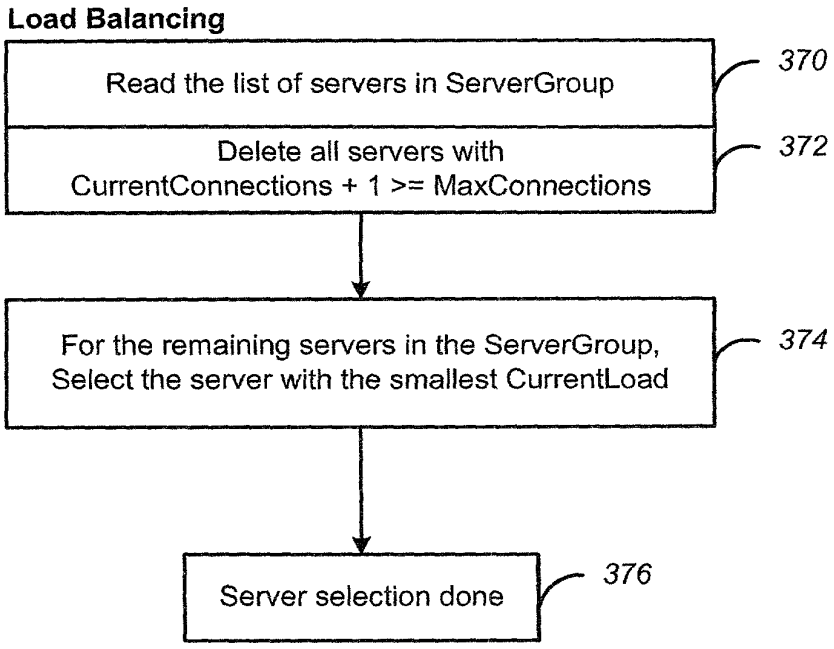


FIG. 11

Docket No. 050805-1041

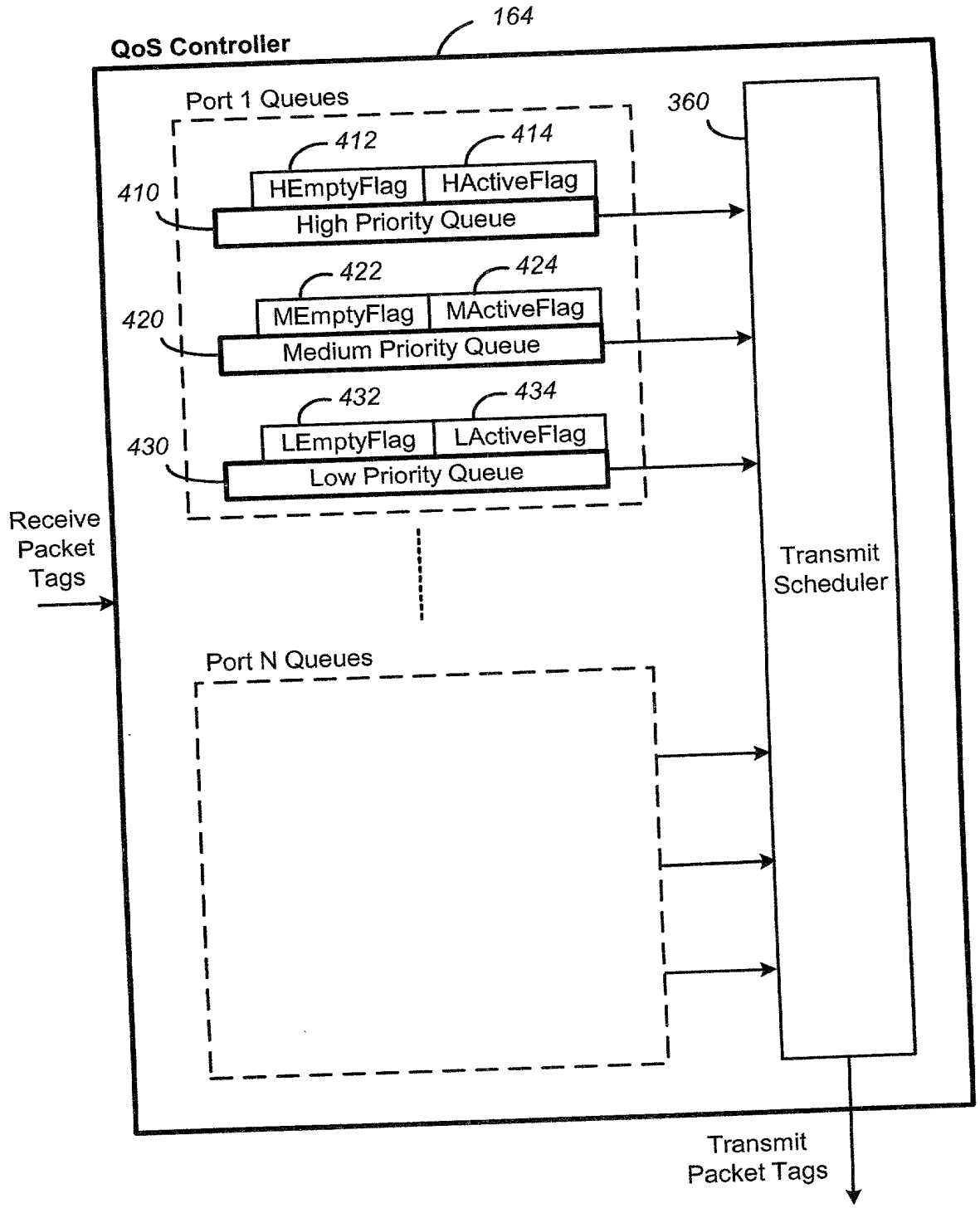
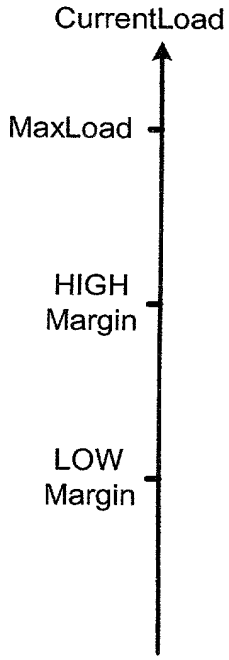

QoS Controller
164
Port 1 Queues
360
412
414
410
HEmptyFlag
HActiveFlag
High Priority Queue
422
424
420
MEmptyFlag
MActiveFlag
Medium Priority Queue
432
434
430
LEmptyFlag
LActiveFlag
Low Priority Queue
Receive
Packet
Tags
Transmit
Scheduler
Port N Queues
Transmit
Packet Tags

FIG. 12



Priority Scheme	HActiveFlag	MActiveFlag	LActiveFlag
High Priority packets allowed, Medium ones retarded	1	Alternate 1 and 0	0
High & Medium Priority packets allowed, Low Priority ones retarded	1	1	Alternate 1 and 0
All Priority packets allowed	1	1	1

FIG. 13

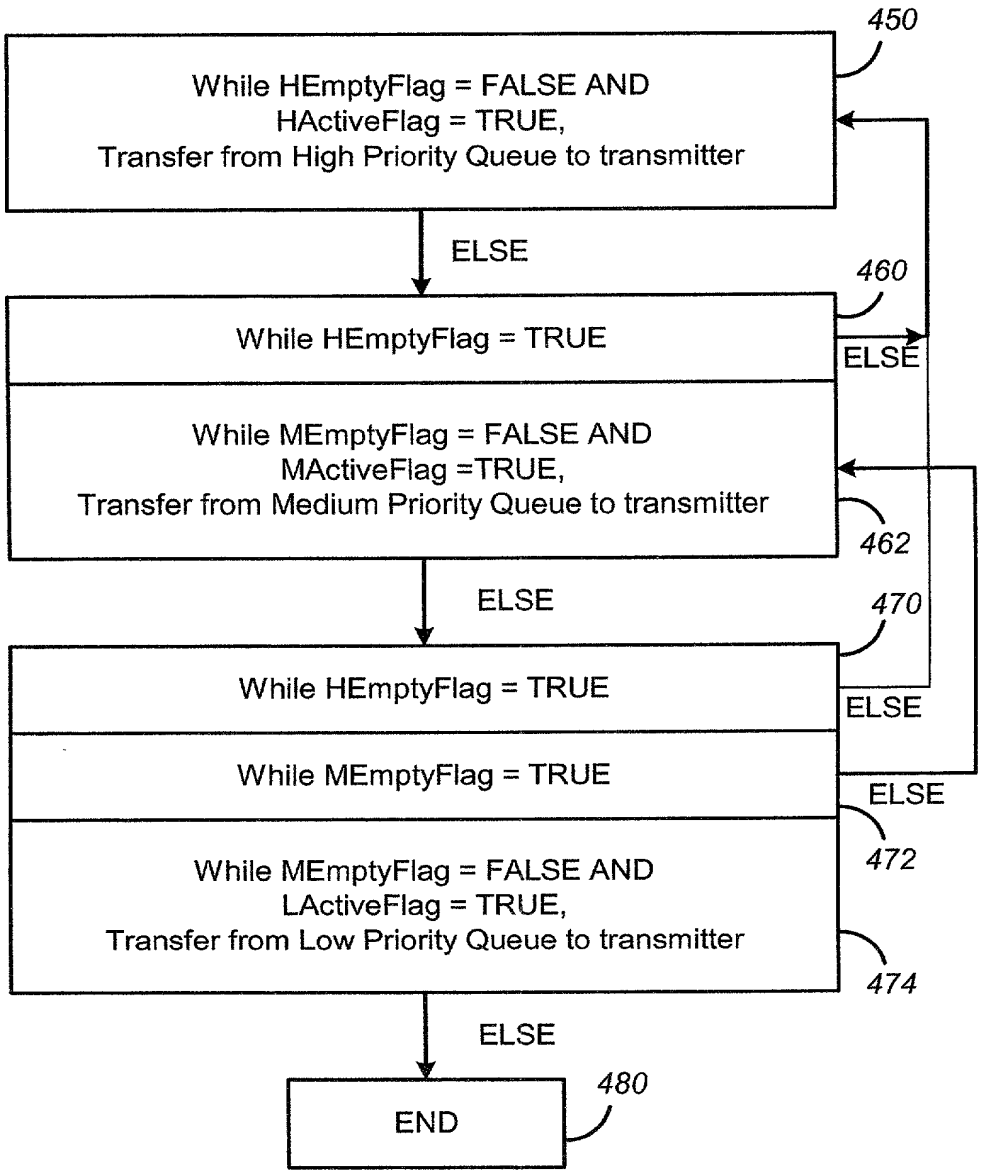

450
While HEmptyFlag = FALSE AND
HActiveFlag = TRUE,
Transfer from High Priority Queue to transmitter
ELSE
460
While HEmptyFlag = TRUE
ELSE
While MEmptyFlag = FALSE AND
MActiveFlag =TRUE,
Transfer from Medium Priority Queue to transmitter
462
ELSE
470
While HEmptyFlag = TRUE
ELSE
While MEmptyFlag = TRUE
ELSE
472
While MEmptyFlag = FALSE AND
LActiveFlag = TRUE,
Transfer from Low Priority Queue to transmitter
474
ELSE
480
END

FIG. 14

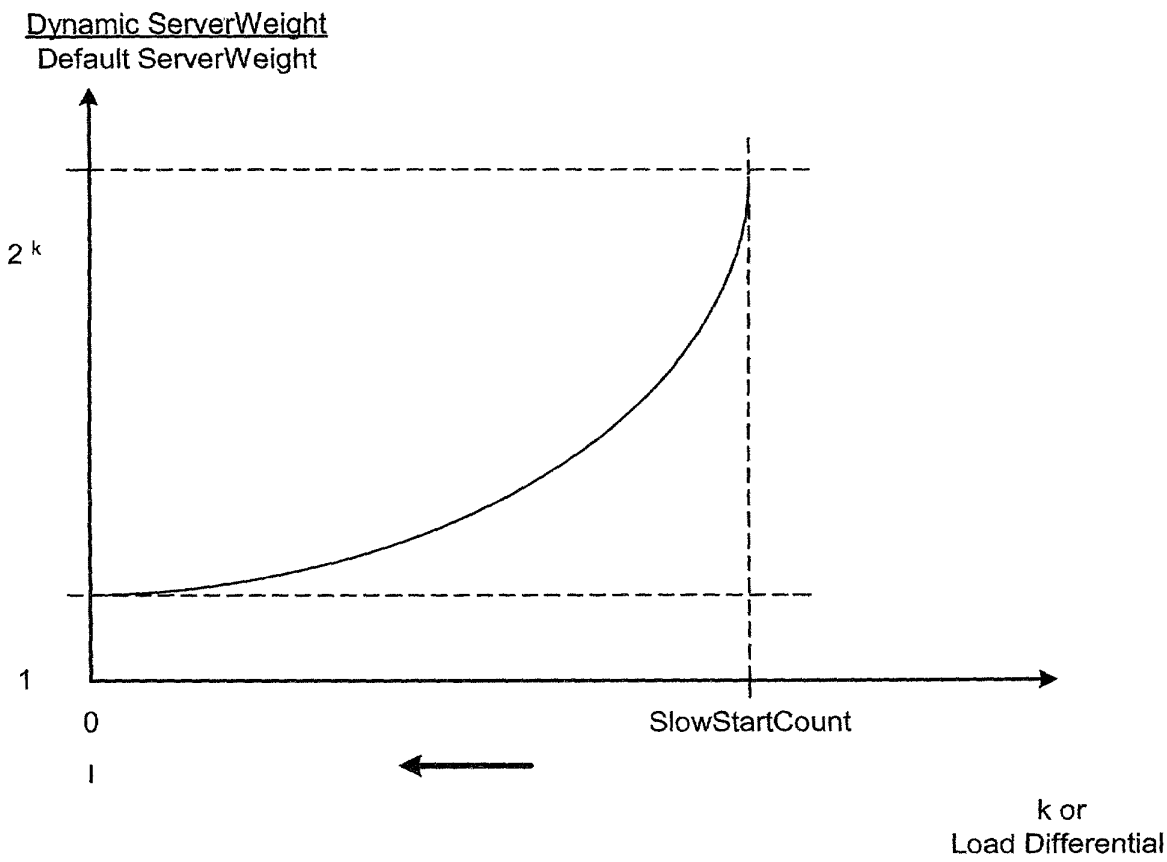

Dynamic ServerWeight
Default ServerWeight
2 k
1
0
SlowStartCount
k or
Load Differential

FIG. 15

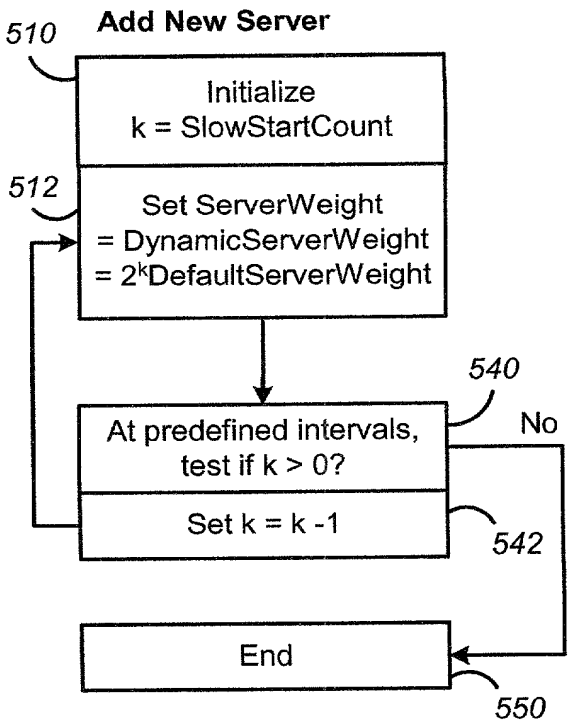


FIG. 16A

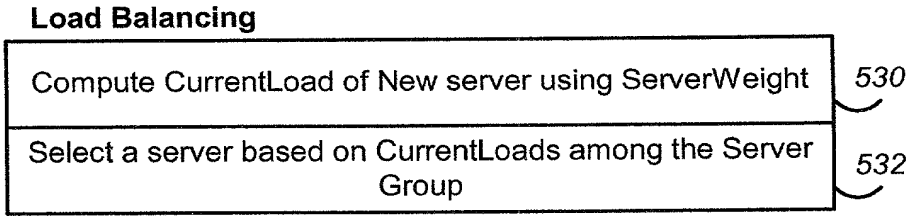


FIG. 16B

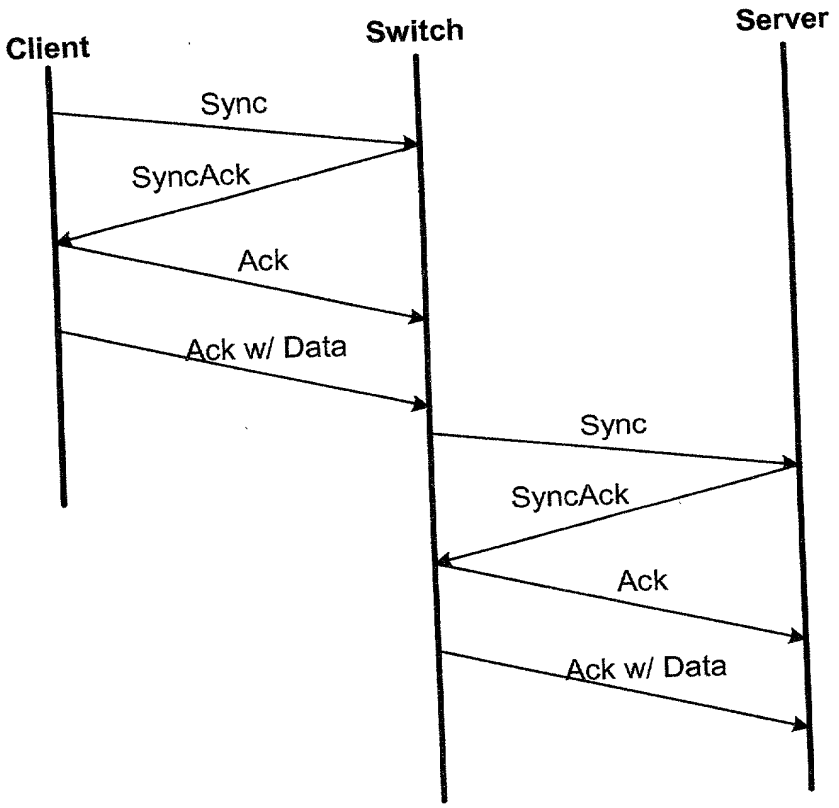


FIG. 17 TCP Slicing

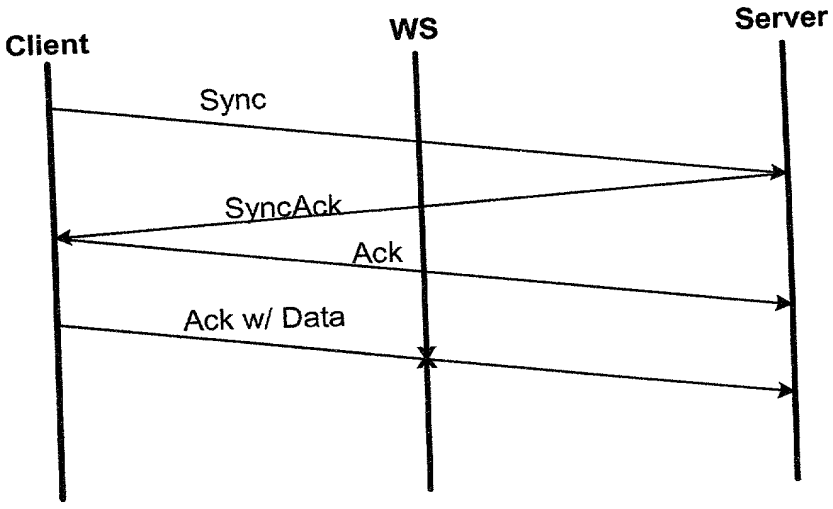


FIG. 18

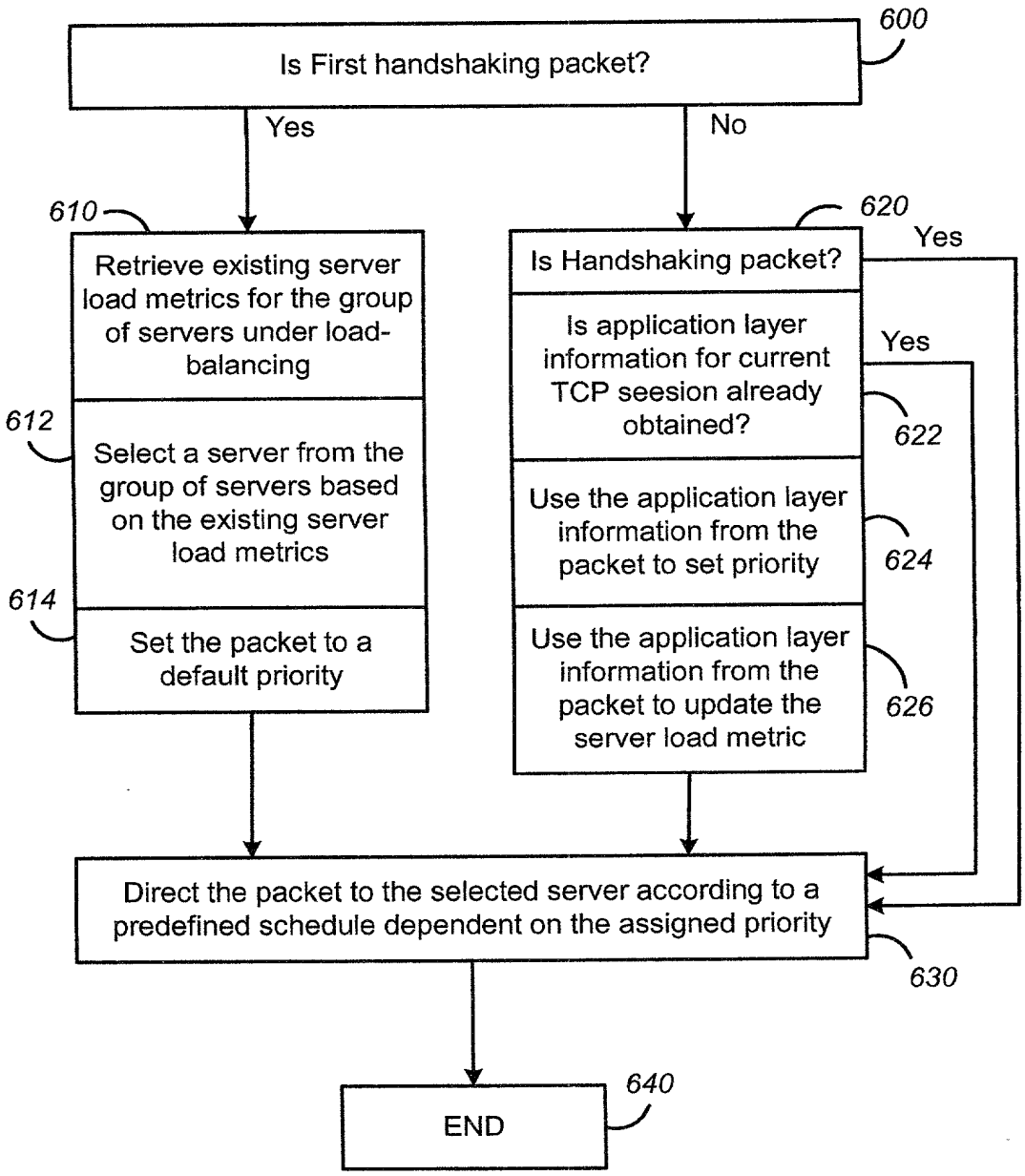

600
Is First handshaking packet?
Yes
No
610
Retrieve existing server load metrics for the group of servers under load-balancing
612
Select a server from the group of servers based on the existing server load metrics
614
Set the packet to a default priority
620
Is Handshaking packet?
Yes
Is application layer information for current TCP seesion already obtained?
Yes
622
Use the application layer information from the packet to set priority
624
Use the application layer information from the packet to update the server load metric
626
Direct the packet to the selected server according to a predefined schedule dependent on the assigned priority
630
END
640

FIG. 19